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A REVIEW ON CRITERIA BASED SOFTWAE COMPONENT SELECTION TECHNIQUES

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ABSTRACT

Component Based Software Engineering uses the principle of software reuse. It helps in developing the large software by combining the already existing module. In CBSE, analyzing & choosing of module is a very complex task but its is important to know how effectively software module is reusable. This paper reviews the criteria base component selection technique namely :-WSM, AHP & HKBS. AHP and WSM both are used previously for analyzing and choosing the module but HKBS is newly introduced technique for module selection Every approach have their own limitations and benefits. The comparision between three of these techniques shows that HKBS is better than other two.Previous experiences of success and failure helps to attain the goal and also reduces time for selecting the module that is effectively reusable.

KEYWORDS: Analytical Hierarchical Processing(AHP), Component Based Software Engineering (CBSE), Component Off The Shelf(COTS), CBR(Case Base Reasoning), Hybrid Knowledge Base System(HKBS), Open Source Software Product(OSSP), Weighted Score Method (WSM)

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Review Article

INTRODUCTION

A component is the module or element that performs various functions independently.It also combines with other modules by the use of middleware. Middleware defines interconnection between modules. CBSE [1] concerns is to establish the system by using already existing modules in order to increase the efficiency. Combining of module take less time in opposition of implementing each module. CBSE introduce philosophy of buying rather than build[2]. For eg: if we wish to make a car engine rather than making each hardware, we simply combine the hardware that was manufactured earlier. The goal is to give equal benefit to the user who uses that s/w for both longer time period or shorter time period. CBSD[3] gives emphasis on reusing the already developed CTOS(Component Off The Shell) modules to build the system. Before combining the module,their functionalities should be checked whether it is according to our requirement or not. If it is suitable one then buy that otherwise other module will be tested in comparision of previous one. **Criteria Based Selection** is the quality, level or degree by which module is selected or judged. It is used as a means of ensuring that the best module is selected by fulfilling all the criterian requirements. Choosing of module is lengthy and complex process. **B**y proper use of previous knowledge[4] we can include CBR in choosing the module. Analyzing and choosing of the module includes concurrently examination of various facts to rank the available modules and choose the desired one. This is MCDM[5] approach in which multiple decision have to be made over multiple criteria. The goal of CBSE is reduce the cost and time of developing large system, product should be efficient and reliable, no errors etc. The

problem arises with the COTS [6,7]components is that user have limited connection with the internal design of product.

FEATURES OF CBSE PROCESS MODEL

To attain the benefit, careful selection of component is necessary. It is the difficult task but this process helps in choosing the best module from various available module. The selection process[6] includes 5 steps :

Evaluate:-This defines the overall specification of system and checking the functionalities of modules which are coming from different vendors.

Selection of module:-In this phase, selection will be done to attain the objective. If the selection is suitable, less effort will be made in future.

Adaptation:-To ensure less conflict between module functionalities, various techniques are used to create a barrier for undesired functionalities.

Integrate:-In this phase, combinig the overall work done into a single unit and testing of that unit will be done.

Update:-After testing,all errors will be removed, if there is any updated version of a s/w that will be updated according to the requirement.

One change in module disturbs the overall system, For the benefit, proper planning should be done before choosing the module. It is a difficult task to choose the best module from various modules and to develop trust on selected module. In section 2, it describes some software component based techniques, section 3 describes comparison between three techniques and section 4 defines conclusion and future work.

COMPONENT BASED SELECTION TECHNIQUES

Weighted Score Method

It [8]is the oldest analysis that are used to choose the module needed for the project This method is used when multiple criteria and multiple modules **($E_1, E_2, \ldots\ldots E_n$)** are available.

WSM[5] uses step by step procedure for the best selection of modules.

- Determine criteria for the best selection of modules.
- Allocate weights (W) and scores (S) to each modules that reflect their importance.
- Multiplication of W and S will be done.
- The greater the weight, the best will be the module for selection.

WSM[9] is measured by using this expression:-

$$\mathbf{S\ (A_i) = \sum W_j\, S_{i\,j}}$$

where W_j is the j^{th} criteria weight and S_{ij} is the score that evaluate performance of Ai over criteria (C j).

This one example define the full procedure of WSM. The hotel services have 4 criteria(Rooms available, Hotel Sevices,Charges, Service Satsfaction) in opposition of 5 modules(i.e A, B, C, D, E). For the final score, multiply the value of each module with the weight and divide it by total weight as shown in Table 1.

Table 1

Criteria	Weights	A	B	C	D	E
Rooms Available	5	2	5	6	5	4
Hotel Services	10	3	3	4	3	1
Charges	15	1	2	3	1	5
Service Satisfaction	20	6	2	2	4	5
Final Score	50 (W)	3.5	2.2	3.1	3	4.1

In the above illustrated example, all the module has less score then E, therefore E is best.

WSM has its own pros and cons:-

Pros:-it is the numerical procedure and for calculation point of view it is easy.(2)This can be used by group of people and individually. **Cons:-**This method is not applicable for whenever there is larger number of modules, as this is used for limited number of modules only.

ANALYTICAL HIERARCHICAL PROCESSSING

This method [9] provide the solution of complicated problems. In 1970's it was introduced by Thomas L. Saaty. In various fields,this method is utilized. This method uses dependent approach and also uses individual thoughts and judgements for making effective decision.

In the process of AHP[10,11], the goal is placed on the top then divide the goal in to sub-goals in the form of tree hierarchy. Secondly determine the criteria to attain the goal and finally ranking of modules will be done according to their importance.

Example of AHP

- Assume we have 5 criteria(OSSP)from which choice has to be made, and its selected qualities (i.e. performance, cost, testing) and then define their importance over one another[12].

For eg: the cost is 3times important than performance and testing is 2 times important than cost. According to the importance, construct the matrix :-

$$p \begin{pmatrix} P & CT \\ 1.0000 & 0.3333 & 2.0000 \\ B= C & 3.0000 & 1.0000 & 0.5000 \\ T & 0.5000 & 2.0000 & 1.0000 \end{pmatrix}$$

- Multiply the matrix in (B X B) form, calculate the eigen vector by adding each row and row totals.

$$\begin{pmatrix} 2.9999 & 4.6600 & 4.1650 \\ D= 6.2500 & 2.9999 & 7.0000 \\ 7.0000 & 4.1650 & 3.0000 \end{pmatrix}$$

E = 11.8249 (row addition)

16.2499

14.1650

42.2398 (row total)

Finally, normalize it by dividing each row sum by total row sum and we get eigen vector as in matrix2.

P 0.2799
C 0.3848
T 0.3353

Matrix 2

- To get the second eigen vector, multiply (D x D) matrix and rest will be same as done previously. So, we get our second eigen vector as shown in matrix 3.

P 0.2909
C 0.3791
T 0.3298

Matrix 3

As both eigen vector values are closely related to each other, so we stop here only. From above, it is considered that primarily cost is important then testing and third is performance.

- For ranking, we considered that for each OSSP, we calculated the related exterior matrix as stated in table 2.

Table 2

	P	C	T
OSSP A	0.3679	0.5136	0.2133
OSSP B	0.5824	0.4532	0.3521
OSSP C	0.1237	0.9218	0.2387
OSSP D	0.4126	0.2881	0.4534
OSSP E	0.8321	0.1217	0.3166

Multiply Table 2 by second eigen vector matrix 3 and we will get final ranking as shown in Table 3.

Table 3

	Multiplication	Rank
OSSP A	0.9720	5
OSSP B	0.4573	2
OSSP C	0.4641	1
OSSP D	0.3787	4
OSSP E	0.3926	3

The above table defines the ranking of the modules. First is OSSP C, second is OSSB B, third is OSSP E and so on.

AHP has pros & cons:-

Pros: It provide clear view for decision process and uses eigen value for ranking**. Cons:** Summation and removal of modules sometimes distrub their ranking, its calculation takes lot of time.

HYBRID KNOWLEDGE BASE SYTEM

In HKBS[13] Approach, knowledge base(KB) are computer system that store expert knowledge and used to provide the solution of the problems. KB consist two modules: knowledge base and inference engine. KB helps the decision engineer in analyzing and choosing of module. It structures the knowledge and provide a tool that helps decision engineer in analyzing and choosing of module. Software module is selected by combining two techniques i.e. CBR and RBR. Rule based reasoning is an unstructured approach in which solution of the problem is given by human experts using knowledge base. Case based reasoning is a structued approach in which solution of the problem is elaborated from previous knowledge.

This technique is developed by Intelligent System Development and solution is introduced by Sonar in 2004 & 2007. HKBS[11,12] uses combination of rule based and case based approach for the better solution of the problem. figure shows HKBS approach:

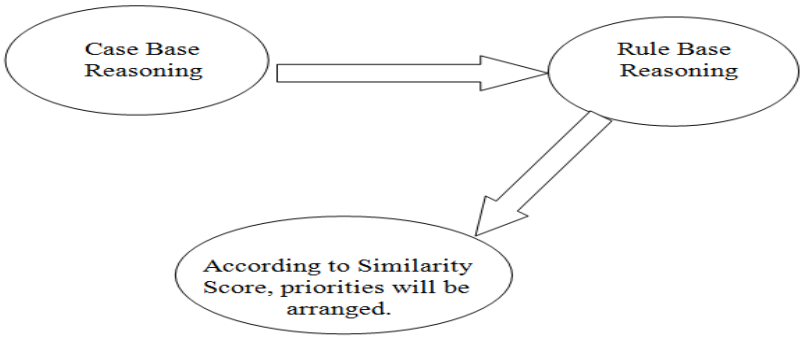

Figure 1

In this Approach, RBR helps decision engineer to: –

- To determine the criteria for analyzing the modules.
- Gathering the requirements of user for the module by using facts and experience the person have.
- Develop the problem case.

Once requirements of user are collected, then these requirements are used as input to the CBR which provide output.

Then CBR helps in:-

- Comparing user requirements of module with the explaination of the candidate module that was stored earlier in the CBR as Cases.
- Restore those modules that are closely related to the user demands of module and then prioritize them accordingly.

HKBS[13] is calculated by using this formula:

$$\frac{\sum_{i=1}^{m} w_i * sim(q_v, c_v)}{\sum_{i=1}^{n} w_i}$$

where Wi is similarity estimate weight and sim(**q**v, **c** v) is the similarity values of query and case. Similarity score defines how effectively user demands of module met with candidate module.

The single similarity outcome is calculated by using the formula:-

$$Sim(qv, cv) = 1 - \frac{d(qv, cv)}{range(v)}$$

$$d(qv, cv) = |qv - cv|$$

$$range(v) = Max\ v - Min\ v$$

where **Max** v is the attribute maximum value and **Min** v is the attribute minimum value.

HKBS has its own pros and cons:-

Pros:- This method is suitable for both larger or limited number of modules.(2) Summation or removal of modules doesnot require much effort for doing the analysis again. (3) It defines whether the selected module is acc to user requirements. **Cons:- F**inding out the similar case from knowledge base consumes lot of time and effort. (2) Previous cases that are stored earlier doesnot provide the idea of latest technologies which we can use now for choosing the module.

HKBS is more efficient than AHP and WSM.

DIFFERENCE BETWEEN AHP,WSM & HKBS

The difference between three of the techniques shows that

HKBS is better than AHP and WSM.

Evaluating Effectiveness

- HKBS works well as subjective as well as objective measure
- HKBS doesnot require much effort

  -If number of modules increases for analysis purpose

  -If changes come in user needs

  -In ranking the effectively reusable module
- HKBS also evaluates whether the selected module are according to the user needs or not

Reuse Experience

- Similar cases that are stored earlier provide experience and knowledge that can be reused for selecting and analyzing the effective module.

Ranking Result

- AHP and WSM shows the correlative ranking of the module where as HKBS shows the result as well as defines how effectively module meets the user needs.
- Summation and removal of software module is easy in HKBS because user module requirement details are stored in case base.

Table 4

Analyzing Modules	AHP	WSM	HKBS
Subjective Measures	√	X	√
If the No. of modules for analysis increases	Comparision have to be made again	Ranking be done again after analyzing the criteria	It does not require much effort
If there is a Alternation of user need	Comparision have to be made again	Need not require much effort	Need not require much effort
Reuse Knowledge	X	X	√
Problem arises in ranking	√	X	X
Objective measures	√	√	√
Specifies whether selected module fulfills user need of that module	X	X	√

CONCLUSIONS

- This paper defines some component based selection (CBSE) techniques like WSM, AHP& HKBS. Each technique has its own pros & cons.
- One of the techniques support limited number of modules and other can handle large number of modules. No one is suitable for each and every case. The future scope is to develop a technique that will provide best solution among all the modules present and also suitable for each and every case.

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